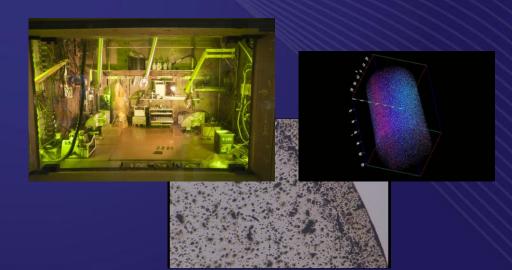
U.S. Department of Energy

Nuclear Energy University Programs

Advanced Fuels – (FC-2)

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Near-Term Goals of Advanced Fuels

Within 5 years, the objective is to complete the transition to science-based fuel development paradigm with state-of the art infrastructure to support the development of

- (a) Next generation LWR fuels with enhanced performance and safety, and reduced waste generation.
- (b) Transmutation fuels with enhanced proliferation resistance and resource utilization.

5 year campaign level objectives

- Maintain progress in baseline technologies with emphasis on fundamental understanding of the fuel fabrication and performance characteristics.
- Support International collaborations for FR fuels
- Identify and assess feasibility of innovative concepts that provide considerable advantages compared to baseline technologies.
- Achieve a state-of-the art R&D infrastructure that can be used to transition to "science-based" approach and accelerate development of the selected concepts
- Select LWR advanced fuel concepts for development towards LTR testing
- Support NEAMS fuel performance code.



Advanced Fuels Campaign Current Research Goals

- Metallic Fuel and Casting Technology:
 - Complete baseline metallic fuel design (for 20% burnup) and quantify main fundamental properties
 - Complete feasibility study of advanced metallic fuel alloy (> 20% burnup)
 - Hot cell demonstration (engineering-scale) of low-loss casting process
- Ceramic Fuels:
 - Develop predictive models (using SET) for oxide fuel thermal conductivity
 - Laboratory-scale demonstration of adjustable, controlled and low-loss sintering
- Core Materials:
 - Qualify the use of HT-9 up to 200 dpa
 - Feasibility demonstration of lined/coated cladding for metal fuels
 - Feasibility demonstration of advanced alloys for LWRs



Advanced Fuels Campaign Current Research Goals

- Irradiation Testing and PIE:
 - Complete assessment of thermal vs fast spectrum irradiation testing
 - Demonstrate advanced techniques for micro- and nano-scale characterization and PIE
 - Deploy an instrumented test in ATR and collect 2-year worth of data
 - Demonstrate feasibility of a novel in-situ instrument for use in ATR tests
 - Develop intellectual and testing infrastructure to be ready for TREAT restart
- Particle Fuels and Other LWR fuels with enhanced Accident Tolerance
 - Demonstrate feasibility of selected concepts and select one or two option for further development towards LTR testing (LTR insertion in 10 years) (delayed with target budget)
 - Feasibility demonstration includes cladding (mechanical properties, steam reactions, FCCI and FCMI) and Fuel (behavior at or near clad failure)



Advanced Fuels Campaign General Areas of Interest

- Advanced fabrication technology and research with potential for decreasing fabrication process losses while increasing fuel quality and consistency
- Fabrication process model development.
- Separate effects and other experimental tests to provide the required fundamental physical and chemical data in support of the development of predictive, physics-based fuels performance models at atomic, microstructural, and continuum levels.
- Development of in-pile instrumentation, novel characterization techniques, and innovative out of pile testing to enable separate efects and other experimental tests at atomic, microstructural, and continuum levels.
- LWR accident tolerant fuel and cladding



LWR Accident Tolerant Fuel and Cladding

- Feasibility studies on advanced fuel and clad concepts
 - bench-scale fabrication
 - irradiation tests
 - steam reactions
 - mechanical properties
 - furnace tests
 - diffusion couples

- Assessment of new concepts
 - Impact on economics
 - Impact on fuel cycle
 - Impact on operational envelope
 - Impact on safety envelope
 - Environmental impact





Work continues in almost all aspects of fuel development

